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Mathematical Problem-Solving Beliefs and Metacognitive Awareness: The Moderating Effect of Mathematical Curiosity

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ABSTRACT

This study employed a descriptive-correlational design to investigate the moderating effect of mathematical curiosity on the relationship between mathematical problem-solving beliefs and metacognitive awareness among college students enrolled at a private university in Davao City. The respondents were identified through cluster sampling. Results revealed that mathematical problem-solving beliefs significantly predict and moderately positively correlate with metacognitive awareness. Mathematical curiosity also predicts metacognitive awareness. However, mathematical curiosity does not significantly moderate the relationship between mathematical problem-solving beliefs and metacognitive awareness. This suggests that a student's beliefs in their problem-solving skills remain a crucial aspect of their metacognitive awareness, regardless of their level of curiosity. Further research is recommended to explore students' gaps, particularly in declarative knowledge and the place of mathematics, and to investigate this study's best-fit model, notably among math majors.

INTRODUCTION

For many years, the main goal of the Department of Education has been to develop mathematically proficient, critical problem-solvers and reflective Filipino learners (DepEd, 2023). However, it contrasts the students' results in both the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS), where they performed poorly and consistently ranked at the bottom (OECD, 2023; TIMSS, 2019). On the comparison between the PISA Mathematics Literacy Framework with the K to 12 Mathematics Curriculum, a study found that the latter fails to promote the application of mathematical concepts to real-life situations where learners need to think more, interpret, and evaluate, as it barely covers the topics needing higher mathematical processes and reasoning skills (Golla & Reyes, 2020). Students' readiness was limited to remembering basic concepts as their year level increased while lacking comprehension and self-regulation strategies, making them prone to errors in solving mathematical problems (Valderrama & Oligo, 2021; Lim *et al.*, 2019).

Metacognitive awareness (MA) is pivotal in students' learning, especially with mathematical concepts in a spiral curriculum (Hacker *et al.*, 2019). Studies revealed that students possessing metacognitive awareness have been taking more control of their learning processes where they choose to develop their skills, especially in identifying strategies that work best for them at solving mathematical problems (Olop *et al.*, 2024; Baguin & Janiola, 2023; Stanton *et al.*, 2021). Moreover, it helps them better understand why they should invest deliberate practice and concentration in their learning, resulting in positive attitudes toward achieving academic success (Mondal, 2023; Anthonysamy, 2021). Thus, there is a need to identify the possible factors that may improve the students' metacognitive awareness.

Additionally, the Growth Mindset theory emphasizes that students face challenges and achieve their goals in life mainly influenced by their beliefs about their intellectual capacity (Wolcott *et al.*, 2021; Dweck, 2006). Students with a growth mindset tend to believe that they can enhance their use of metacognitive methods and strategies and are likely to take part in challenging mathematical problems that confront the actualization of mathematical concepts (Sturm & Bohndick, 2021; Bernecker & Job, 2019). It only means that their metacognitive awareness and beliefs influence their learning and problem-solving approach (Yorulmaz *et al.*, 2021). Hence, the key to learners' academic success and improvements in behavioral performance is fostering their metacognitive awareness through positive attitudes and beliefs toward their school and learning, making them willingly accept challenging, nonroutine problems.

Mathematical problem-solving beliefs (MPB) refer to how students perceive their abilities and view mathematics as a subject. Studies found that when students hold positive beliefs, it plays a significant role in improving their learning, which also helps them become more motivated to engage with mathematical tasks (Sintema & Mosimege, 2023; Sopekan & Awofala, 2019; Yavuz & Erbay, 2014). Several critical aspects of mathematical problem-solving beliefs contribute to students' overall problem-solving capabilities, namely, mathematical skills involving the

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basic skills used to solve problems, developed and applied in a real-world context (Sabasaje & Oco, 2023; Vohra, 2022), the place of mathematics refers to how versatile mathematics is in its application in various fields such as in the development of society (Yadav, 2020; Hansson, 2019), understanding the problem involves students' ability to recognize what is known and what needs to be solved, which may include looking at the situation from different angles (Sekaryanti *et al.*, 2022; Tan, 2021), the importance of mathematics lies in how it helps simplify daily tasks and improve decision-making (Ojose, 2011), and problem-solving skills which refer to applying strategies and reaching out the solutions (Mohammed, 2024; Herrity, 2024; Bariyyah, 2021).

Aside from MPB, metacognitive awareness is the most essential variable to explore. It refers to an awareness of one's thinking process and how it regulates and works, divided into six indicators (Baguin & Janiola, 2023; Montillado & Lovitos, 2023; Özçakmak *et al.*, 2021; Arum *et al.*, 2019). First, declarative knowledge is knowing, describing, and understanding what are the strategies to be used (Tak *et al.*, 2022; Ramadhanti & Yanda, 2021); second, procedural knowledge means how these processes or strategy applied to perform the tasks (Telaumbanua *et al.*, 2024; Amin *et al.*, 2022); third, conditional knowledge refers to when and why to use those strategies for that tasks (Güner & Erbay, 2021; Stanton *et al.*, 2021); fourth, planning which focuses on to what are the students are aiming to learn, what strategic skills to be used to come up with solutions, and how they will going to perform it (Agudelo-Correa, 2020; Adinda, 2021); fifth, monitoring is when the students are constantly tracking down their learning progress or performance if they are doing well or if they need to adapt better learning strategies (Rhodes, 2019; Norman *et al.*, 2019); and sixth is evaluation, in which the students received feedbacks and reflects about their outputs.

Moreover, mathematical curiosity (MC) is an intrinsic drive to acquire knowledge for deeper understanding, further strengthening memory, and enhancing learning (Chen *et al.*, 2022). This is supported by the Dynamic Systems Theory (DST) of Epistemic Curiosity by Subaşı (2019), which states that curiosity is a dynamic and context-dependent process influenced by cognitive (prior knowledge, perceived knowledge gaps, and metacognitive awareness), emotional (excitement, uncertainty, or frustration when faced with new information), and environmental factors (learning environment, instructional strategies, and social interactions). Also, studies have found that curiosity enhances interest in mathematics, prompting mathematics students to tackle complex problems and reinforcing their confidence in problem-solving abilities (Peterson & Cohen, 2019; Zetriuslita *et al.*, 2024), which contributes to their academic success (Bayuningrum *et al.*, 2021; Zetriuslita & Ariawan, 2021). Thus, given its dynamic nature, mathematical curiosity is a potential variable that may moderate the relationship between mathematical problem-solving beliefs and metacognitive awareness.

Subsequently, the researchers acknowledged that few studies were conducted to find a significant relationship between metacognitive awareness and mathematical problem-solving beliefs (Yorulmaz *et al.*, 2021; Ajan *et al.*, 2021). Also, how college students' mathematical curiosity may moderate this relationship has not yet been explored. This implies that this study will provide data that will serve as a basis for new researchers to further explore the moderation of mathematical curiosity on the relationship between mathematical problem-solving beliefs and metacognitive awareness.

Investigating this study develops a foundation for understanding the students' metacognitive awareness, problem-solving beliefs, and curiosity about mathematics. This research primarily explores how important it is to transform students' fixed mindset into a growth mindset about their learning ability and assess external factors to induce high utilization of cognitive awareness. Specifically, it provides insights regarding the effects of curiosity on their learning processes under certain conditions. The study also highlights the gap between the Department of Education's objectives and Filipino students' poor performance in international assessments. Ultimately, the findings support Sustainable Development Goal (SDG) 4—Quality Education—by helping raise educational quality and preparing students to meet real-world challenges.

In this study, the researchers examined the level of college students' mathematical problem-solving beliefs regarding mathematical skills, the place of mathematics, understanding the problem, the importance of mathematics, and problem-solving skills. Also, their level of metacognitive awareness in declarative knowledge, procedural knowledge, conceptual knowledge, planning, monitoring, evaluation, and mathematical curiosity were measured. Additionally, this study assessed whether a significant correlation exists between mathematical problem-solving beliefs and metacognitive awareness, and that mathematical curiosity moderates this relationship. Finally, this study verified the hypothesis that there is no significant relationship between mathematical problem-solving beliefs and metacognitive awareness, and that mathematical curiosity does not moderate the relationship between mathematical problem-solving beliefs and metacognitive awareness at a 0.05 significance level.

MATERIALS AND METHODS

Respondents

The target respondents were 30,468 college students enrolled in a private university in the Davao Region during the first semester of the School Year 2024-2025. Out of this number, only 380 participated, as Bujang (2024) supported that having participants of at least 149 was already sufficient for conducting correlational research. Moreover, given the large population, cluster sampling was performed to divide it into smaller groups with similar characteristics, yielding reliable results (Simkus, 2023). Furthermore, data were collected from respondents in three selected buildings on campus, each representing a different college: the BE building for the College of Accounting Education (134), the GET building for the College of Criminal Justice Education (134), and the DPT building for the College of Arts and Science Education (112).

Instrument

Three instruments were used in this study, and all were 5-point Likert-type questionnaires with response options of 5 as strongly agree to 1 as strongly disagree. The first questionnaire, the Mathematical Problem-Solving Beliefs Scale (Bal, 2015), was modified and consisted of 26 items across five indicators: mathematical skills (7 items), the place of mathematics (5 items), understanding the problem (3 items), the importance of mathematics (6 items), and problem-solving skills (5 items). In the scale, the 2nd, 4th, 9th, 15th, 20th, 21st, and 26th were originally reversed but changed into non-reversed items.

The second questionnaire, the Metacognitive Awareness Inventory, was adapted from Tak *et al.* (2022) and includes 30 items divided into six indicators: declarative knowledge (5 items), procedural knowledge (4 items), conditional knowledge (5 items), planning (5 items), monitoring (6 items), and evaluation (5 items). Lastly, the Mathematical Curiosity Inventory was adapted from Belecina and Ocampo (2016) and has 30 items. These three instruments were validated by experts and got a Cronbach's alpha of 0.906, 0.943, and 0.925, respectively. The range of means of 4.20-5.00 is very high, indicating that the students always manifested mathematical problem-solving beliefs, metacognitive awareness, and mathematical curiosity. While 3.40-4.19 is classified as high, the students often manifested mathematical problem-solving beliefs, metacognitive awareness, and mathematical curiosity. Then, 2.60-3.39, classified as moderate, means that the students sometimes manifested mathematical problem-solving beliefs, metacognitive awareness, and mathematical curiosity. Moreover, 1.80-2.59, classified as low, where students seldom manifested mathematical problem-solving beliefs, metacognitive awareness, and mathematical curiosity. Furthermore, 1.00-1.79 was very low, implying that the students never manifested mathematical problem-solving beliefs, metacognitive awareness, and mathematical curiosity.

Design and Procedure

This study employed a descriptive-correlational research design that describes and determines the relationship between the two variables (Brodowicz, 2024). This design was the most appropriate since this study examines the levels of the respondents' beliefs, metacognitive awareness, and curiosity without manipulating these variables. It also ought to determine if there was a naturally occurring relationship between mathematical problem-solving beliefs and metacognitive awareness and how mathematical curiosity might affect this relationship.

Before data collection, the researchers requested approval by sending formal letters to the Deans of the colleges located in the selected three buildings. The researchers then asked for the consent of the respondents, who were also fully informed of the study's purpose, procedures, and their right to withdraw at any time. Additionally, they were assured that the research team strictly maintained their privacy and confidentiality.

For data analysis, the statistician calculated the mean and standard deviation to describe the levels of mathematical problem-solving beliefs, metacognitive awareness, and curiosity among respondents. The Spearman's rho correlation was used to determine the relationship between mathematical problem-solving beliefs and metacognitive awareness since the data were not normally distributed. Furthermore, a moderation analysis was conducted to examine whether mathematical curiosity strengthens or weakens the relationship between mathematical problem-solving beliefs and metacognitive awareness.

RESULTS AND DISCUSSIONS

Level of Mathematical Problem-Solving Beliefs

Data reveals that college students have a very high level of mathematical problem-solving beliefs (M = 4.34, SD = 0.45). This suggests that they exhibit confidence in believing that mathematics is an essential tool beyond calculations that enhances intelligence and simplifies real-world situations. They also demonstrate persistence as they believe their mathematical skills are developed through practice and dedicated study while recognizing its deep connection to their daily life. In addition, they approach problem-solving tasks strategically and reflectively, embrace challenges, explore multiple solutions, and show resilience in overcoming difficulties.

Table 1: Level of Mathematical Problem-Solving Beliefs of College Students

Indicators	Mean	SD	Description
Mathematical Skill (MS)	4.48	0.51	Very High
The Place of Mathematics (PM)	4.13	0.69	High
Understanding the Problem (UP)	4.63	0.54	Very High
The Importance of Mathematics (IM)	4.24	0.63	Very High
Problem-Solving Skills (PS)	4.24	0.58	Very High
Overall Mean	**4.34**	**0.45**	**Very High**

Moreover, the indicator with the highest mean is understanding the problem (M = 4.63, SD = 0.54). This means that these students have a very high belief that solving mathematical problems requires an understanding of the concepts. Also, dealing with its difficulties provides new ways to find solutions and develops valuable problem-solving skills. The lowest mean was obtained by the place of mathematics (M = 4.13, SD = 0.69). This implies that the learners do not fully believe that mathematics is essential to them, that it is related to general science, and that they can use it through technology –contributing to their difficulty in fully engaging with mathematical concepts.

These findings confirm the studies of Sopekan and Awofala (2019) and Yavuz and Erbay (2014), where pre-service teachers were generally found to have a high level of belief in mathematical problem-solving. The abovementioned also aligns with the view of Sintema and Mosimege (2023) that students hold strong beliefs about understanding the concepts in solving mathematical problems, showing motivation and perseverance in grasping complex concepts. However, these students are partially unconvinced in its practical use, making them less likely to apply mathematical concepts to real-world problems.

Level of Metacognitive Awareness

Displayed in Table 2 is the respondents' high level of metacognitive awareness (M = 4.04, SD = .54). Data suggests that these students have organized knowledge, know how to identify essential information, and carefully read instructions before solving the tasks. They also select and apply practical problem-solving approaches and assess their understanding by questioning their methods. In addition, after completing a task, they evaluate their performance, consider alternative approaches, and summarize their learning, contributing to their academic success.

Table 2: Level of Metacognitive Awareness Among College Students

Indicators	Mean	SD	Description
Declarative Knowledge (DK)	3.88	0.68	High
Procedural Knowledge (PK)	4.05	0.66	High
Conditional Knowledge (CK)	4.11	0.61	High
Planning (PL)	4.17	0.65	High
Monitoring (MO)	4.01	0.67	High
Evaluation (EV)	4.00	0.70	High
Overall Mean	**4.04**	**0.54**	**High**

Moreover, planning received the highest mean score (M = 4.17, SD = 0.65), indicating that when starting a task, studentsreflect on prior knowledge, set key information, read instructions carefully, select effective problem-solving strategies, and know how to manage their time efficiently. However, declarative knowledge has the lowest mean (M = 3.88, SD = 0.68), suggesting that while students can recognize, organize, and retain essential information and assess their understanding, there is room for improvement in fully grasping and applying learned concepts.

This result aligns with the studies of Arum *et al.* (2019), Baguin and Janiola (2023), and Montillado and Lovitos (2023), highlighting students' high metacognitive awareness. The former found that students can understand the problem, develop a solution according to the plan, and critically evaluate their results by reviewing and verifying their calculations to ensure accuracy and effectiveness. The latter observed that students with strong metacognitive skills tend to excel in mathematics, as their ability to implement effective learning strategies enhances their academic success.

Level of Mathematical Curiosity

Presented in Table 3 is the respondents' high level of curiosity for learning mathematics (M = 3.91, SD = 0.62). This means students frequently seek opportunities to discover how things work with riddles, abstract theories, and other mathematical concepts. They also actively engage with the lessons as they feel at ease whenever they can solve complex problems. In addition, they evaluate their strengths and areas for improvement and regularly reflect on their learning experiences to grow as a person.

Table 3: College Students' Level of Mathematical Curiosity

Items	Mean	SD	Description
1. I would describe myself as someone who actively seeks as much information as I can in a new situation.	4.08	0.80	High
2. I find myself looking for new opportunities to grow as a person (e.g., new concepts, collaborating with peers, and using resources).	4.15	0.77	High
3. I actively seek as much information as I can in new situations.	4.17	0.80	High
4. I am at my best when doing something that is complex or challenging.	3.92	0.89	High

5. I am always looking for experiences that challenge how I think about myself and the world.	4.11	0.83	High
6. I frequently seek out opportunities to challenge myself and grow as a person.	4.04	0.89	High
7. When I am actively interested in something, it takes a great deal to interrupt me.	4.16	0.89	High
8. Everywhere I go, I am curious about new mathematical ideas or theories.	3.55	1.11	High
9. I like to do things that are a little frightening.	3.87	0.96	High
10. I prefer math tasks that are excitingly unpredictable.	3.41	1.16	High
11. I am the kind of learner who embraces unfamiliar math problems, topics, and theories.	3.51	1.14	High
12. Difficult conceptual problems can keep me awake all night thinking about solutions.	3.50	1.15	High
13. I enjoy learning about math topics that are unfamiliar to me.	3.46	1.15	High
14. I can spend hours on a single problem because I just can't rest without knowing the answer.	3.53	1.14	High
15. If I read something that puzzles me at first, I keep reading until I understand it.	4.08	0.90	High
16. It bothers me if I come across a word that I don't know, so I will look up its meaning in a dictionary.	4.19	0.90	High
17. I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it.	4.02	0.91	High
18. I brood for a long time in an attempt to solve some fundamental problem.	3.87	0.93	High
19. I am critical of current ideas and theories.	3.73	0.92	High
20. I enjoy discussing abstract concepts.	3.72	0.99	High
21. If I am given an incomplete puzzle, I like to try to find the final solution.	3.89	1.00	High
22. When someone asks me a riddle, I am interested in trying to solve it.	3.89	1.01	High
23. When I am given a new kind of arithmetic problem, I enjoy imagining solutions.	3.60	1.05	High
24. When I see a complicated piece of machinery, I like to ask someone how it works.	3.93	0.97	High
25. I enjoy exploring new ideas.	4.23	0.84	Very High
26. I find it fascinating to learn new information.	4.20	0.84	Very High
27. If I am given an unfamiliar task, I like trying how it gets done.	4.11	0.88	High
28. When I learn something new, I would like to find out more about it.	4.16	0.87	High
29. When I see an incomplete puzzle, I like imagining how to solve it.	4.01	0.91	High
30. I am interested in discovering how things work.	4.36	0.82	Very High
Overall Mean	**3.91**	**0.62**	**High**

Moreover, only three items got a very high mean, with item 30 being the highest (M = 4.36, SD = 0.82), followed by item 25 (M = 4.23, SD = 0.84), then item 26 (M = 4.20, SD = 0.84). These results suggest that students are strongly inclined toward exploration and discovery in mathematics. Their curiosity drives their willingness to tackle unfamiliar problems and expand their understanding of mathematical theories and applications. Furthermore, the results of this study are supported by Peterson and Cohen (2019) and Zetriuslita *et al.* (2024), who claim curiosity has been a critical factor in students' interest in mathematics. When students enjoy learning mathematical concepts regardless of the medium of learning, this leads to solving even more complex or non-routine problems. Also, this process helps students find solutions that strengthen their confidence in their problem-solving skills.

Relationship between Mathematical Problem-Solving Beliefs and Metacognitive Awareness

Table 4 highlights Spearman's rho correlational analysis of the relationship between mathematical problem-solving beliefs and metacognitive awareness of college students. Data reveals a significant moderate positive relationship between mathematical problem-solving beliefs and learners' metacognitive awareness, r (378) = .656, p = .000, hence, the null hypothesis is rejected. This means that learners with stronger beliefs in mathematical problem-solving are more likely to have higher metacognitive awareness. Also, they value and engage deeply in problem-solving and tend to reflect more on their thinking processes and use metacognitive strategies to enhance their learning.

Table 4: Correlation Between Mathematical Problem-Solving Beliefs and Metacognitive Awareness

Mathematical Problem-Solving Beliefs	Metacognitive Awareness						
	DK	PK	CK	PL	MO	EV	Overall Mean
MS	.350*	.412*	.475*	.410*	.403*	.367*	.484*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
PM	.355*	.338*	.373*	.280*	.335*	.377*	.407*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
UP	.320*	.409*	.438*	.347*	.336*	.347*	.433*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
IM	.477*	.472*	.537*	.493*	.436*	.451*	.571*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
PS	.492*	.520*	.566*	.503*	.464*	.423*	.594*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Overall Mean	**.525***	**.562***	**.621***	**.528***	**.518***	**.527***	**.656***
	(.000)	**(.000)**	**(.000)**	**(.000)**	**(.000)**	**(.000)**	**(.000)**

**. Correlation is significant at the 0.05 level*

The highest correlation is between problem-solving skills and conditional knowledge, which falls to a moderate positive correlation, r (378) = .566, $p < .001$. This indicates that students with well-developed problem-solving skills demonstrate strong conditional knowledge. Also, they can recognize when and why to apply different strategies in mathematical problem-solving, adapting effectively to various problem contexts. On the other hand, the weakest correlation is between the place of mathematics and planning, which is categorized as a negligible correlation, r (378) = .280, $p < .001$. This suggests that the student's beliefs about the role of mathematics in different contexts have minimal influence on their ability to plan their learning and problem-solving strategies.

Moreover, these findings affirm the claims of Yorulmaz *et al.* (2021) and Ajan *et al.* (2021) that there is a medium and significant relationship between metacognitive awareness and mathematical problem-solving beliefs. These results also follow Dweck's Growth Mindset Theory (2006), which asserts that individuals' beliefs about their intellectual abilities influence how they face challenges and strive for success. Further, similar claims by Sturm and Bohndick (2021) and Bernecker and Job (2019) support this idea, highlighting that those with a growth mindset believe in improving through effort. This belief fosters the development of the learners' metacognitive strategies, motivating them to engage with complex mathematical problems and enhance their conceptual understanding.

Moderating Effect of Mathematical Curiosity in the Relationship between Mathematical Problem-Solving Beliefs and Metacognitive Awareness

A moderation analysis was conducted as this study explored whether mathematical curiosity moderates the relationship between mathematical problem-solving beliefs and metacognitive awareness. Table 5 visualizes the overall model that explains 64.1% of the variance in metacognitive awareness, leaving 35.9% of the variance unexplained by the model $R^2 = .641$, $F(3,376) = 223.280$, $p < .001$. It was hypothesized that the relationship between mathematical problem-solving beliefs and metacognitive awareness would be more evident among individuals with higher levels of mathematical curiosity.

Table 5: Moderating Role of Mathematical Curiosity on the Relationship Between Mathematical Problem-Solving Beliefs and Metacognitive Awareness

	B	SE	t	P
Mathematical Problem-Solving Beliefs	.516	.043	11.758	.000
Mathematical Curiosity	.449	.031	14.532	.000
Mathematical Problem-Solving Beliefs X Mathematical Curiosity (Interaction)	.032	.052	.615	.539
Low (-.615 SD)	.496	.048	10.383	.000
Average (0 SD)	.516	.044	11.758	.000
High (+.615 SD)	.536	.060	8.900	.000

Note: Constant = 4.031, $R^2 = .641$, $F(3,376) = 223.280$, $p < .001$

Data shows that mathematical problem-solving beliefs significantly predict metacognitive awareness (B = .516, $p < .001$), suggesting that students with stronger beliefs in their problem-solving abilities tend to have higher metacognitive awareness. Similarly, mathematical curiosity (B = .449, $p < .001$) also predicts metacognitive awareness.

However, the interaction between mathematical problem-solving beliefs and mathematical curiosity ($B = .032$, $p = .539$) is not statistically significant, implying that mathematical curiosity does not moderate this relationship; hence, we failed to reject the null hypothesis. Particularly, the results revealed that regardless of whether a person has low ($B = .496$, $p < .001$), average ($B = .516$, $p < .001$), or high curiosity ($B = .536$, $p < .001$) about mathematics, their belief in their problem-solving abilities consistently contributes to their metacognitive awareness.

The findings of this study partially align with the Dynamic Systems Theory (DST) of Epistemic Curiosity by Subaşı (2019), which emphasizes the evolving and context-dependent nature of curiosity in learning. The predictive effect of mathematical curiosity on metacognitive awareness supports DST's claim that curiosity enhances engagement and self-regulation. The nonsignificant moderation of mathematical curiosity challenges DST's assumption that mathematical curiosity interacts with mathematical problem-solving beliefs to enhance metacognitive awareness. Also, this result contrasts with Peterson and Cohen (2019) and Zetriuslita *et al.* (2024), who emphasize curiosity's role in deepening students' understanding and problem-solving skills. This discrepancy may be because of contextual factors such as the respondents' courses, cognitive load, instructional strategies, and how curiosity operates in their mathematical learning.

CONCLUSION

Results revealed that students have very high mathematical problem-solving beliefs and, at the same time, have high metacognitive awareness and mathematical curiosity. A significant moderate positive relationship exists between mathematical problem-solving beliefs and metacognitive awareness. Also, mathematical problem-solving beliefs and curiosity were identified as predictors of metacognitive awareness. However, mathematical curiosity does not moderate the relationship between mathematical problem-solving beliefs and metacognitive awareness. The findings indicate that students with higher mathematical problem-solving beliefs are more likely to have higher metacognitive awareness. Furthermore, those with well-developed problem-solving skills are better at applying various strategies to solve mathematical problems. On the other hand, regardless of students' level of curiosity in math, their confidence and belief in their problem-solving abilities remain a key factor in their metacognitive awareness. The correlation strongly conforms to the Growth Mindset Theory, indicating that the more the students are motivated to engage with complex mathematical problems, the more they understand, monitor, and regulate their thinking and learning processes. However, the nonsignificant moderation contradicts the Dynamic Systems Theory (DST) of Epistemic Curiosity, which assumes curiosity is dynamic and always plays an interactive role in learning processes. This implies that strong problem-solving beliefs can independently drive students to use metacognitive strategies effectively, even without the additional influence of their curiosity. The findings of this study emphasize the strong connection between problem-solving beliefs and metacognitive awareness yet reveal areas that need attention. Further studies should explore students' gaps, particularly in declarative knowledge and the place of mathematics. This result gives educators insights into adopting strategies that reinforce students' foundational knowledge and boost appreciation for the practical value of mathematics. Educators should also consider building students' confidence, enhancing metacognitive skills, and inspiring curiosity, ultimately empowering learners to approach mathematical challenges with more remarkable persistence, autonomy, and critical thinking. Moreover, future researchers are encouraged to investigate this study's best-fit model with mathematics majors as respondents.

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